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Earth-Sun System Technology Office

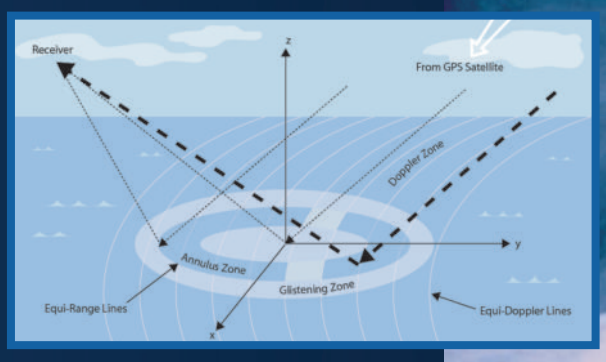
WINDEX: a GPS Reflection System for Ocean Surface Winds

Filling the gap between space-based and buoy or dropsonde instruments, an aircraft-borne GPS reflection system can provide continuous, high-resolution measurements of ocean surface wind speeds. The Wind Explorer (WINDEX) instrument has been demonstrated for extended observations on a regional scale and may soon prove to be a vital asset for storm tracking, weather forecasting, and the characterization of ocean wind fields.

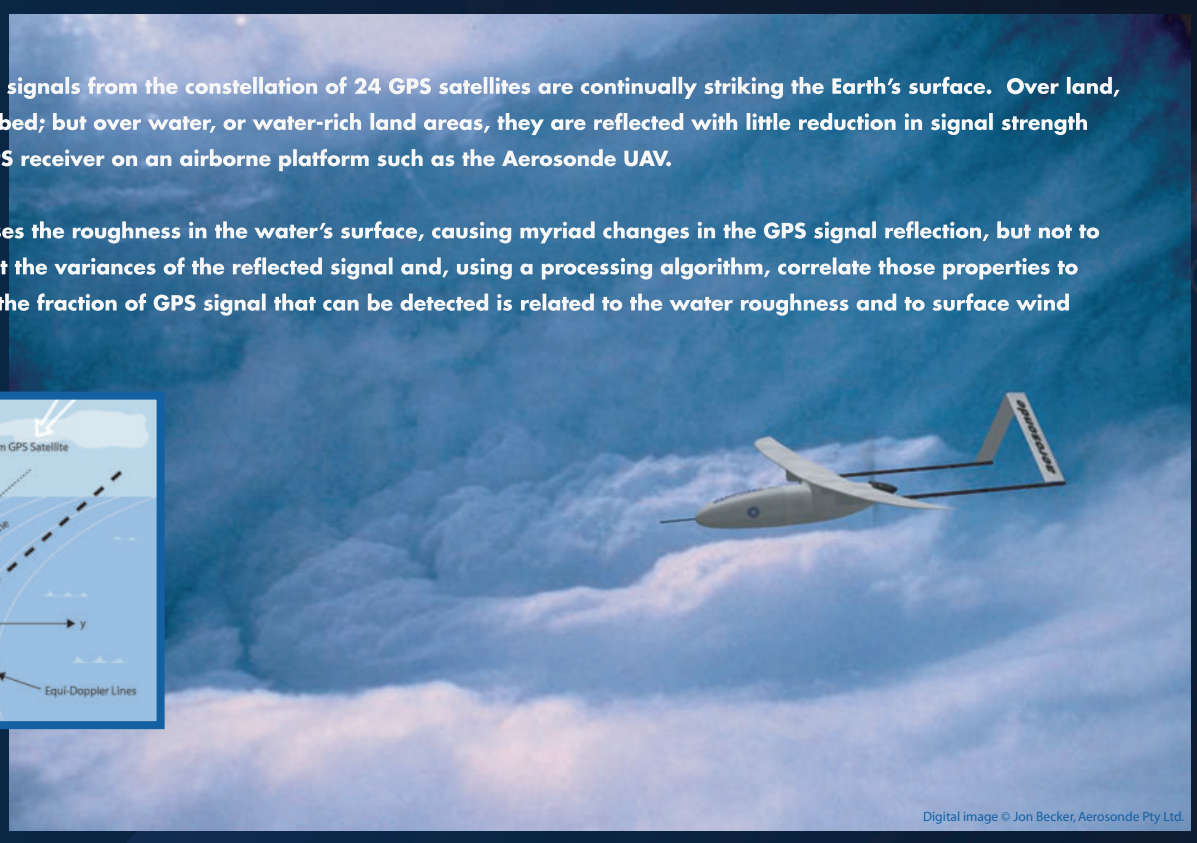
How it Works

L-band Global Positioning System (GPS) signals from the constellation of 24 GPS satellites are continually striking the Earth's surface. Over land, many of these signals are simply absorbed; but over water, or water-rich land areas, they are reflected with little reduction in signal strength and can be detected by the WINDEX GPS receiver on an airborne platform such as the Aerosonde UAV.

Wind acting on a body of water increases the roughness in the water's surface, causing myriad changes in the GPS signal reflection, but not to the signal strength. WINDEX can detect the variances of the reflected signal and, using a processing algorithm, correlate those properties to determine surface wind speed. That is, the fraction of GPS signal that can be detected is related to the water roughness and to surface wind speed and direction.



Ocean-reflected GPS signals take the form of nearly concentric ellipses. Their surface areas contribute to the detected signal so long as there are waves with correct slope to redirect the incoming GPS.



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Features and Benefits

- **Low mass (2.5kg), low volume (23cm x 13cm x 19cm), low power (15W) package can be flown on almost any platform, including high-altitude UAVs**
- **Existing transmitter source (L-band GPS) is not affected by rain or clouds, unlike scatterometers or microwave radiometers**
- **Provides near continuous data points – approximately every 200 meters – that can fill in the gaps between buoy or parachute deployed dropsonde measurements**
- **Wind speed measurements have an accuracy of approximately ±10 percent for winds below 24 meters per second (48 knots)**

Future Applications

- **GPS reflection technique can also be utilized for soil moisture measurements (as a function of GPS reflection signal strength) as well as to identify freeze/thaw conditions**
- **Small, light package could be easily affixed to fleets of commercial airplanes to provide nearly global measurements of ocean surface winds**

Acknowledgments

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